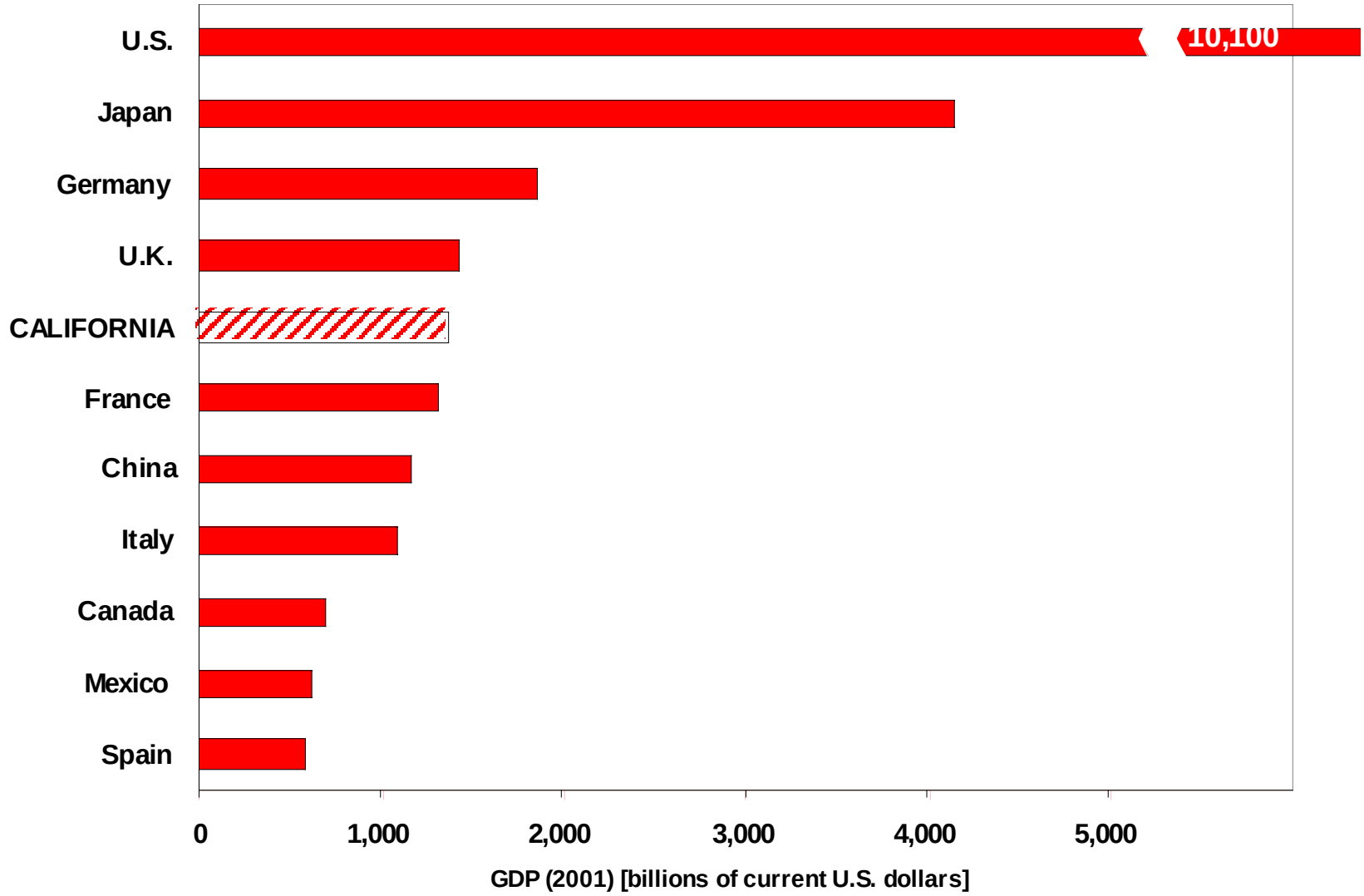
Stanford/Livermore Workshop
On
Climate Change Technology Initiative

Terry Surles

California Energy Commission

August 26, 2003

GDP (2001)


U.S.
Japan
Germany
U.K.
CALIFORNIA
France
China
Italy
Canada
Mexico
Spain
10,100
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1,000
2,000
3,000
4,000
5,000
GDP (2001) [billions of current U.S. dollars]

California has Established a $62M/yr Public Interest Energy Research Program (PIER)

Economy: Affordable Solutions

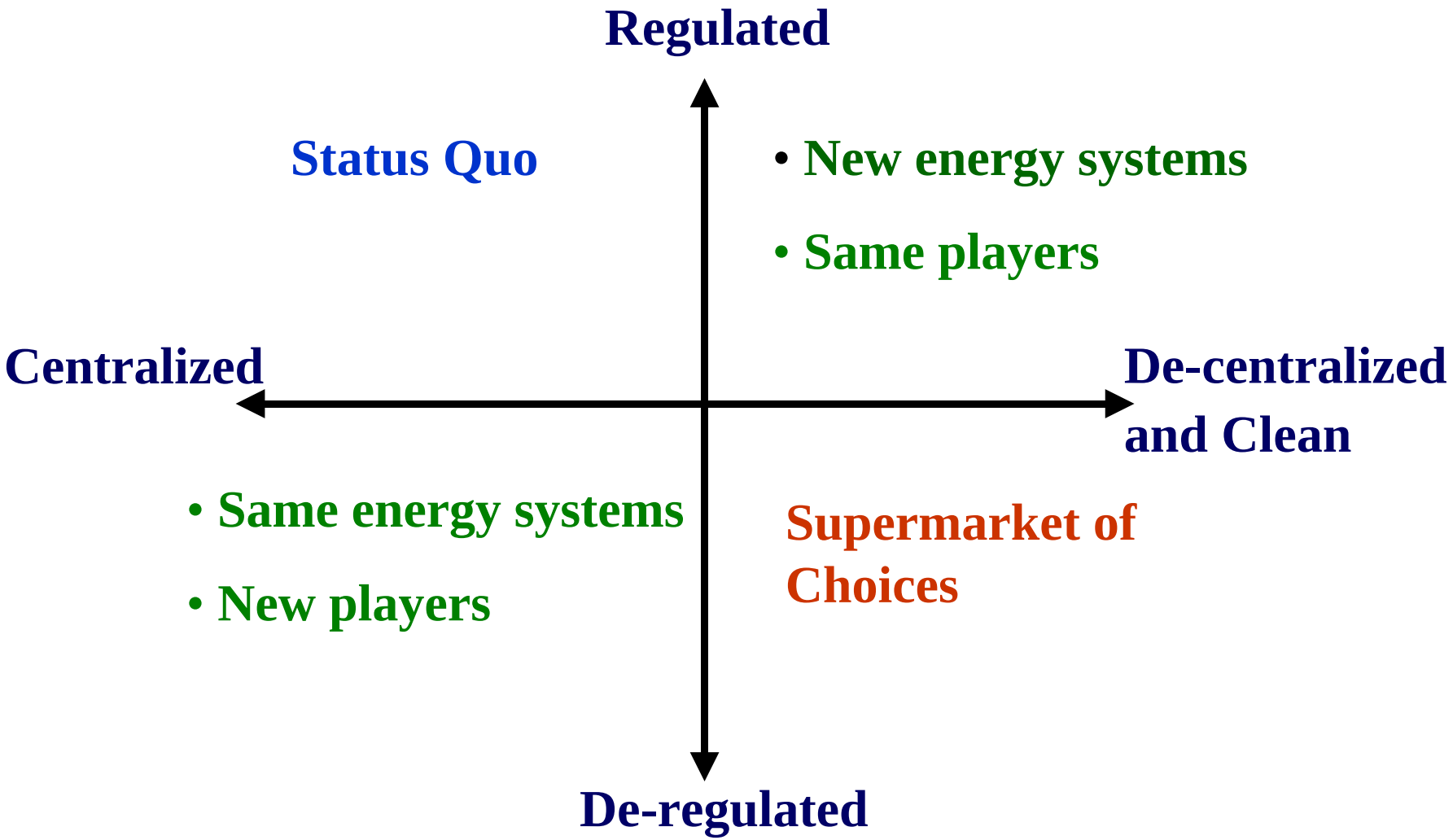
Quality: Reliable and Available

Environment: Protect and Enhance

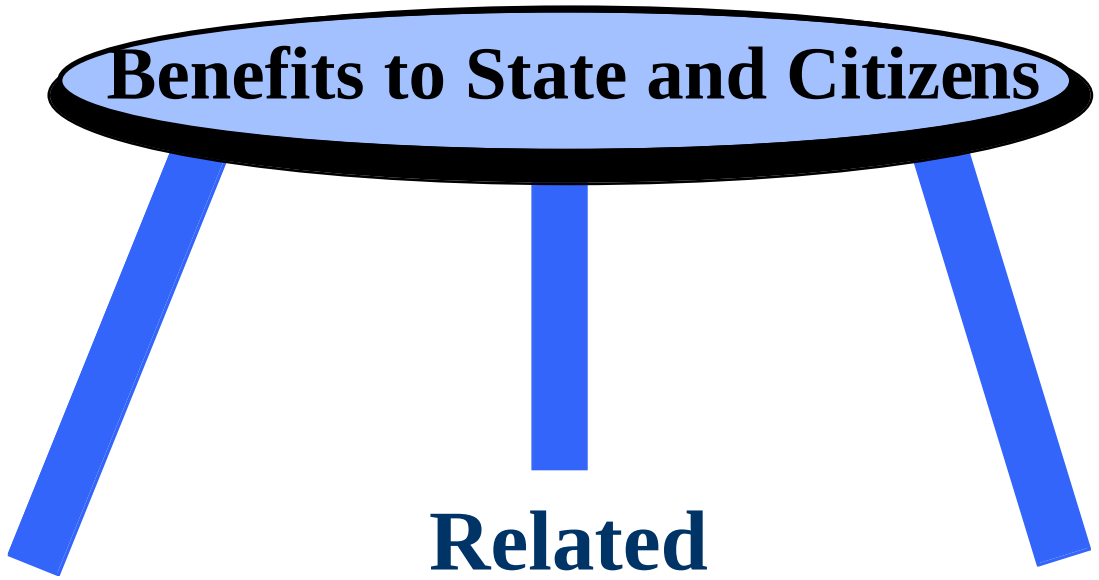
PIER Public Benefit Objectives were Modified in 2002 Using Argonne Multi-Attribute Decision Analysis

- Improve energy cost/value
- Improve environment, public health, and safety
- Improve electricity reliability/quality/sufficiency
- Provide greater consumer choice
- Develop near-term applications
- Address research gaps

PIER Must Have A Vision to Address Future Scenarios: Decentralization, Environment, and Choice



Policy and RD&D Must Be Linked in Order to Provide Benefits to the State



Our Success is Coupled to the Successes of our Technology Partnerships

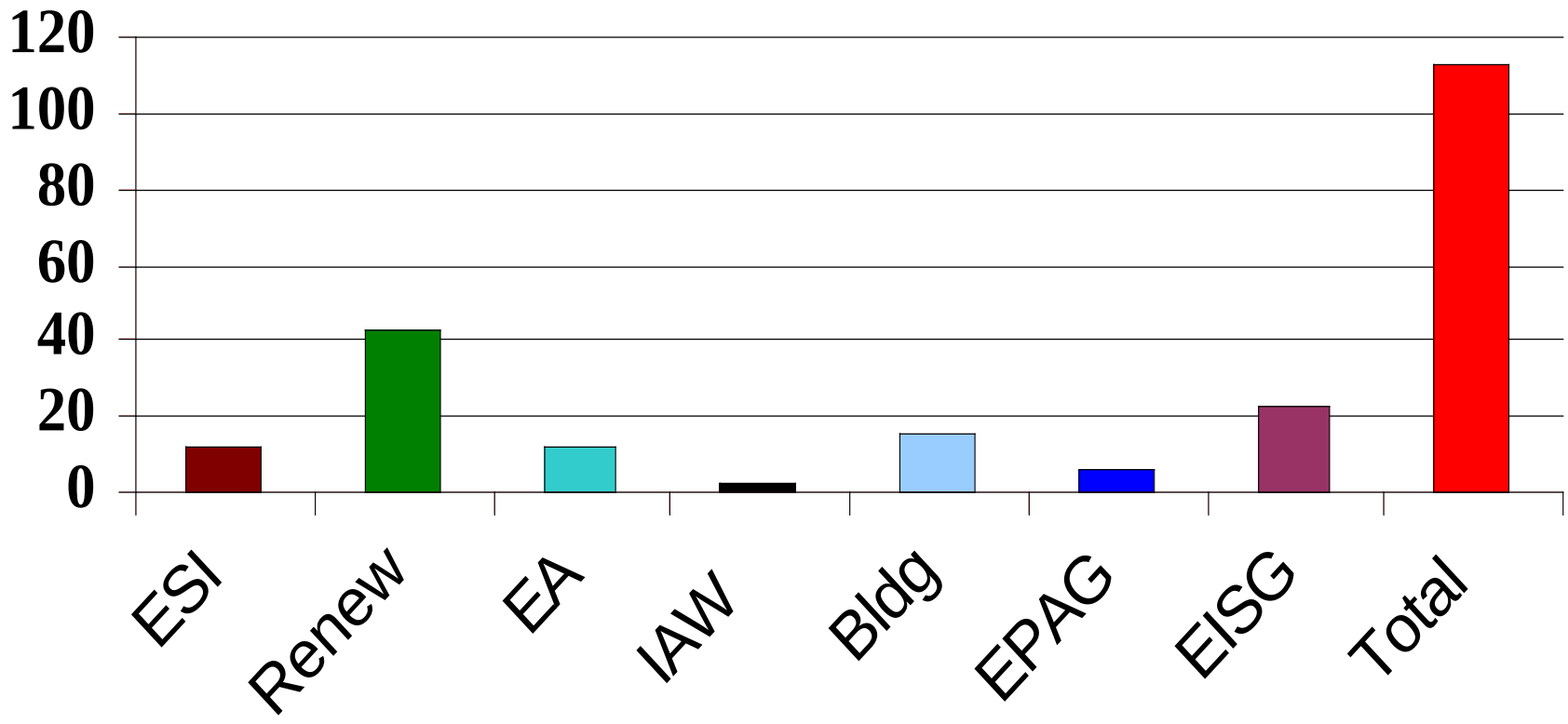
- **Universities – UCOP, standard contract**
- **Industries – funding, obtaining co-funding, pushing deployment**
- **Federal – Departments of Energy, Commerce, Agriculture**
- **National Laboratories – LBNL, NREL, LLNL, ORNL, NETL, SNL, ANL**
- **State – ARB, CDF, DWR, DOGGR, CFA, CPA, CPUC, DGS**

RD&D Activities Should Connect with Synergistic State Regulatory, Incentive, and Subsidy Programs

- **Buildings** – Titles 20 and 24
- **Renewables** – Renewable portfolio standard (RPS)
- **Environmentally-Preferred Advanced Generation** – 2007 ARB rules on distributed generation emissions
- **Energy Systems Integration** – CPUC/CEC initiatives in demand response/dynamic pricing, distributed energy resources, and transmission and distribution systems
- **Environmental** – Impacts/opportunities related to RPS, state initiatives (AB 1493) in climate change

$ External Funding Into State

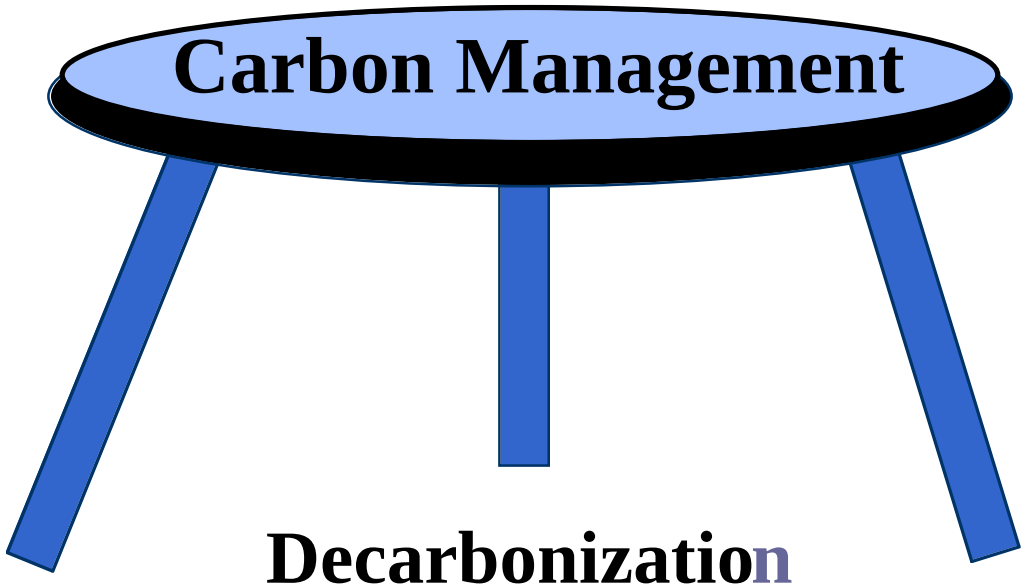
(in $ Millions)



Some Specific Collaborative Programs (All DOE Unless Noted)

- **Energy Systems Integration**
  - Microgrid – DIS, NREL
  - CERTS – LBNL, EPRI, SNL
  - CITRIS – UCB, DARPA
- **Renewables**
  - Wind, biomass, BIPV - NREL, various
  - MSW-EPA
- **Environmental**
  - Climate Change Center -NOAA, Scripps
  - Sequestration – NETL, various
- **IAW**
  - COPE – NETL, USC
  - SIOF
- **Buildings**
  - Building envelopes, appliances – LBNL
  - Cool roofs – LBNL, ORNL
- **EPAG**
  - ARICE – LLNL, ANL, WAUKESHA
  - SOFC – LLNL, various
  - Microturbines – Catalytica, Solar Turbines
  - CO2 separation – CES, LLNL

CEC R&D Program for Improving Efficiency and Developing Distributed Resources also Addresses Climate Change



Efficiency

$$< \frac{\text{Btu}}{\text{GSP}}$$

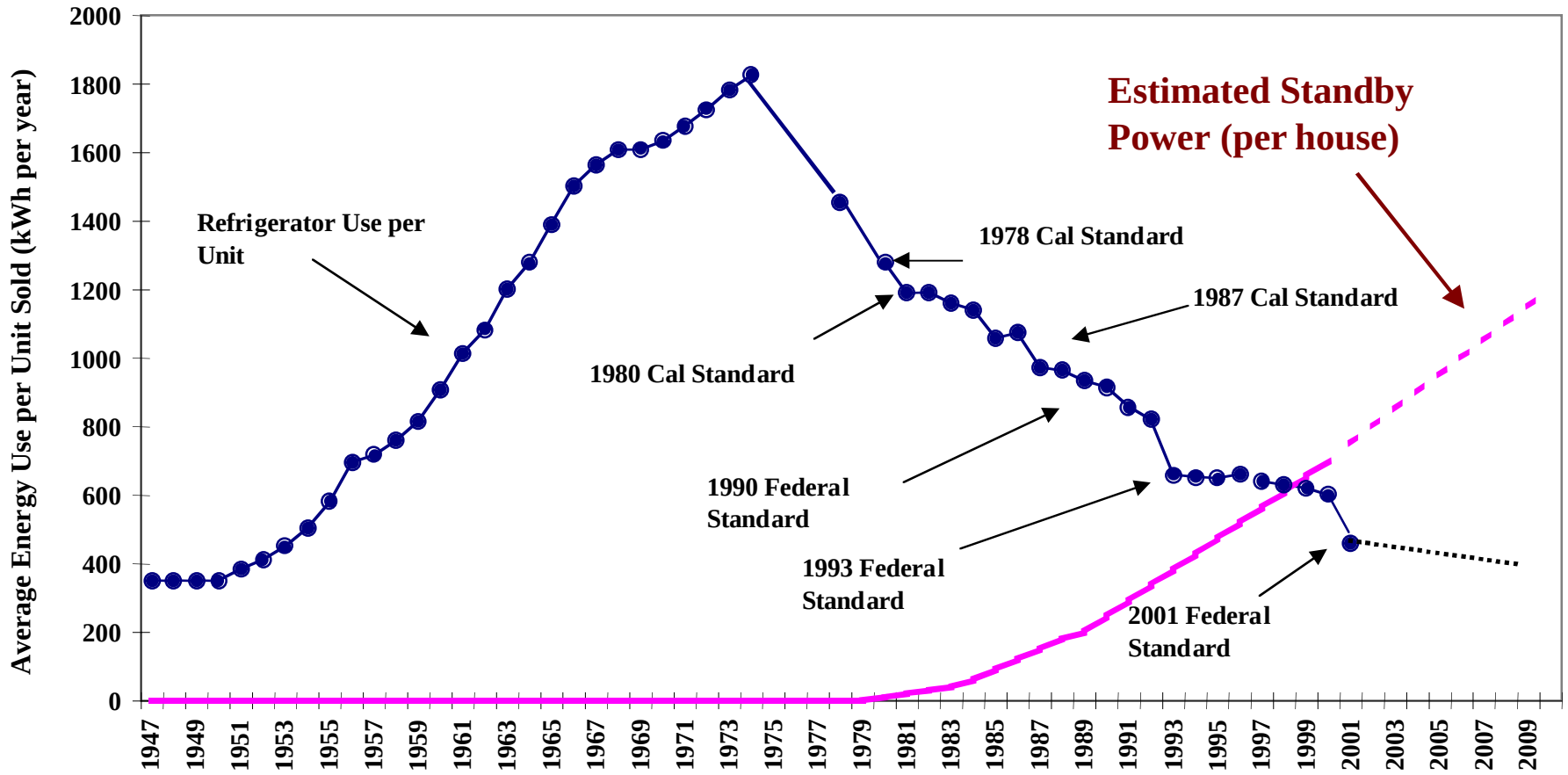
Decarbonization

$$< \frac{CO_2}{\text{Btu}}$$

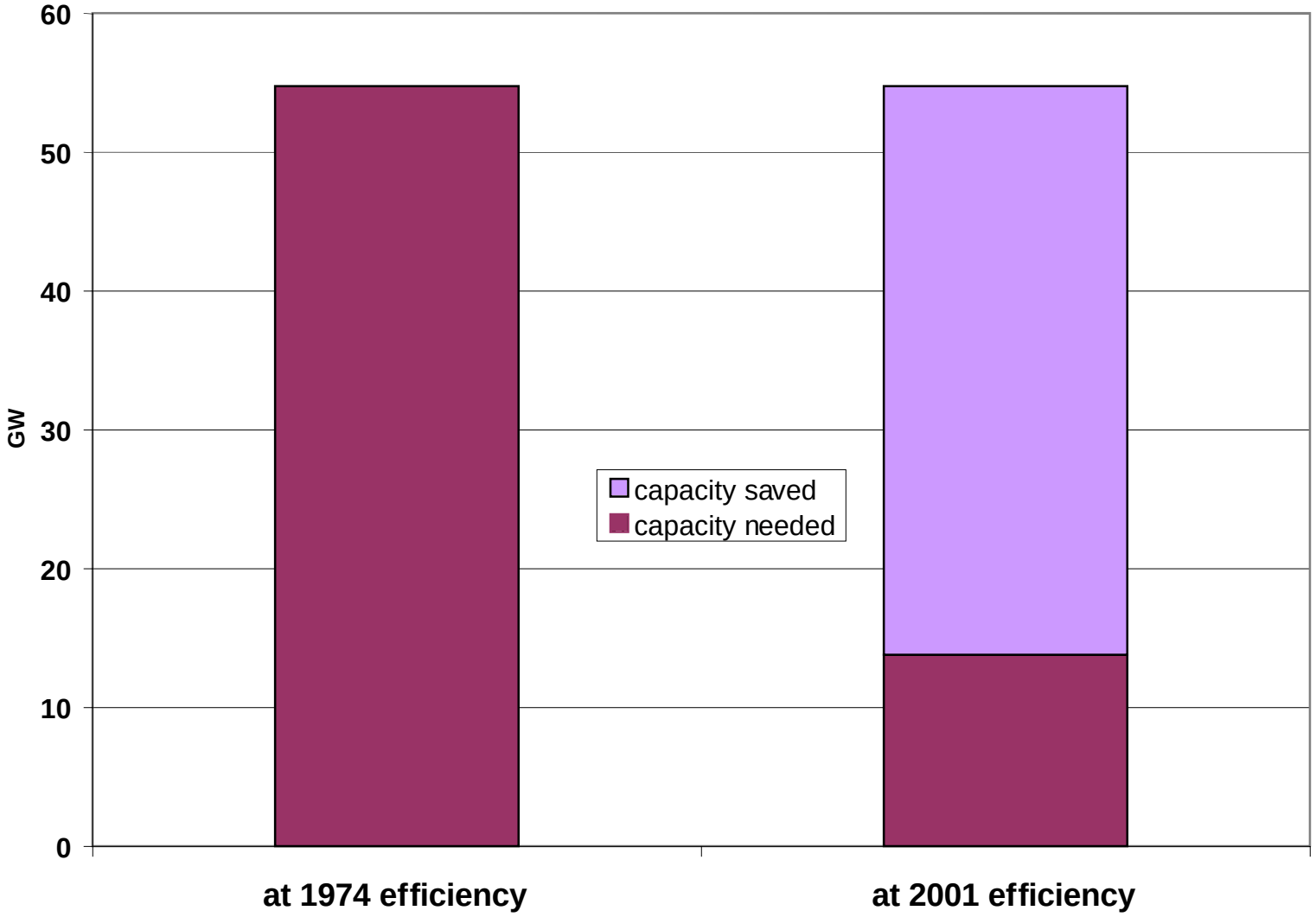
Sequestration

$$< \frac{CO_2 \text{ atm}}{CO_2 \text{ produced}}$$

United States Refrigerator Use (Actual) And Estimated Household Standby Use v. Time



Electricity Generating Capacity for 150 Million Refrigerators + Freezers in the US



Berkeley Lamp

- **Model partnership between CEC/DOE/California utilities**
  - **PIER funded Phase 1 to develop task/ambient lamp concept**
  - **DOE funded Phase 2 to develop specific lamp configuration**
  - **PIER was instrumental in moving the technology into the marketplace via coordination with the Utility Emerging Technology Coordinating Council**

Project is both a technical success and a customer success

RD&D for Industry, Agriculture & Water

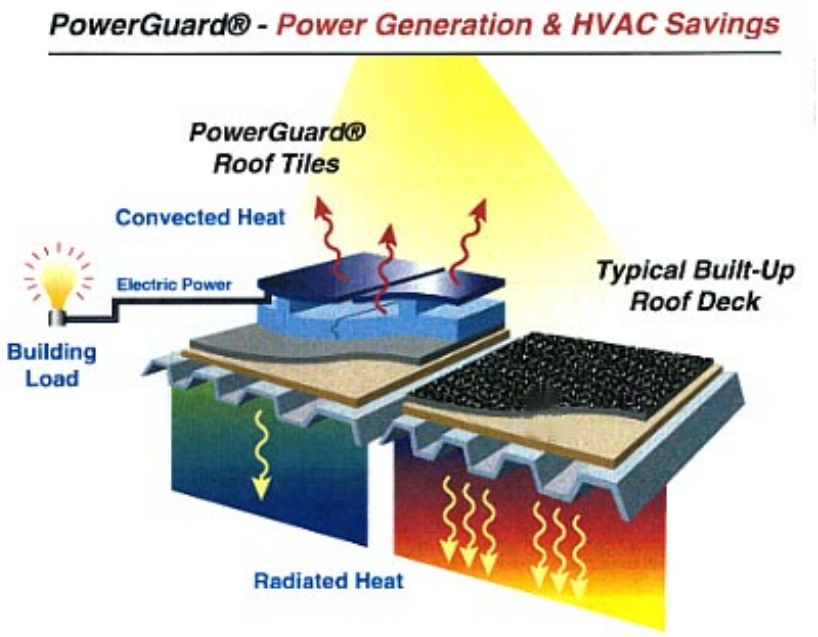
Technology

- Redesigned fumehood for cleaning contaminated indoor air

Benefits

- Saves up to 50% of the energy
- Applicable in electronics fabrication,
- Pharmaceuticals, biomedical and chemical industries
- 30,000 fumehoods in California
- Potential to save $30 million per year in California

PowerLight's PowerGuard



While California is known for its hot dry summers, that same solar resource provides a clean, safe and reliable way to generate electricity

PowerLight's insulated 30 year roof system reduces building air conditioning loads while it's PV surface generates electricity during hot and expensive peak summer hours

The Yolo County Success

Accomplishments

- Is opening the way for landfill gas electricity systems to be more widely used in California
  - Accelerates gas production from over 30 years to less than 10 years, making landfill electricity more competitive
  - Reduces volume of landfill which can extend landfill life by 20 percent
  - Significantly reduces the chance for groundwater pollution from leachate release
- Has become the leading bioreactor project within EPA's XL Program and will strongly influence landfill regulations across the country

CEC's Role

- Through the CEC's R&D programs, we're bringing bioreactor technology from concept to reality

Control cell without bioreactor

Enhanced bioreactor cell

Xonon Cool Combustion System - Catalytica Energy Systems, Inc.

Description:

- Gas turbine combustion system that controls combustion temperature to prevent the formation of NO_X

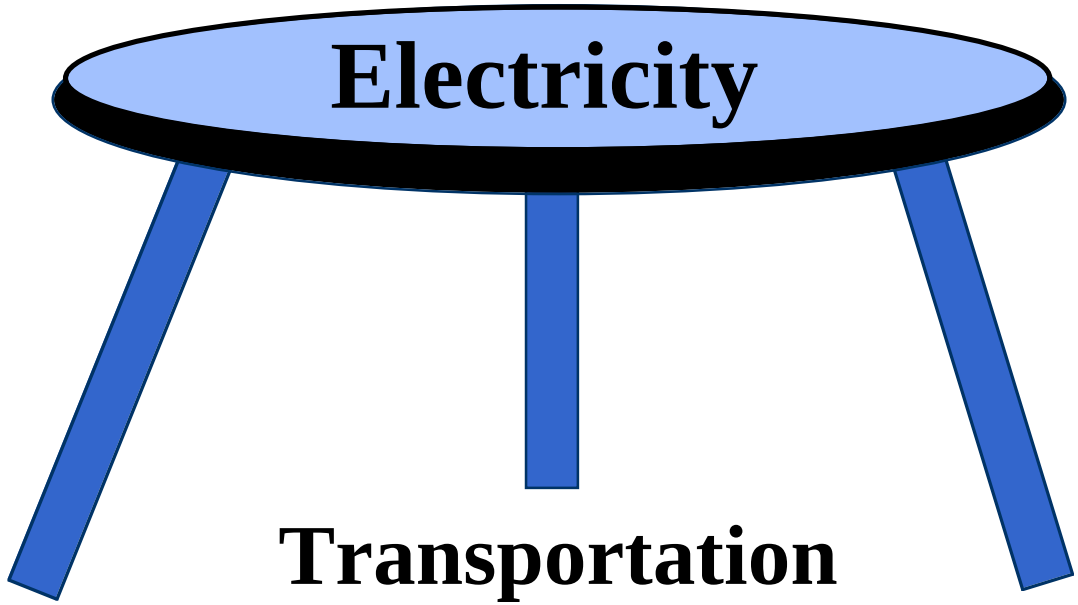
Benefits:

- Lower NO_X emissions without SCR
- Allows deployment of smaller turbines for DG
- Expandable to large, central station turbines
- Use with Kawasaki turbine

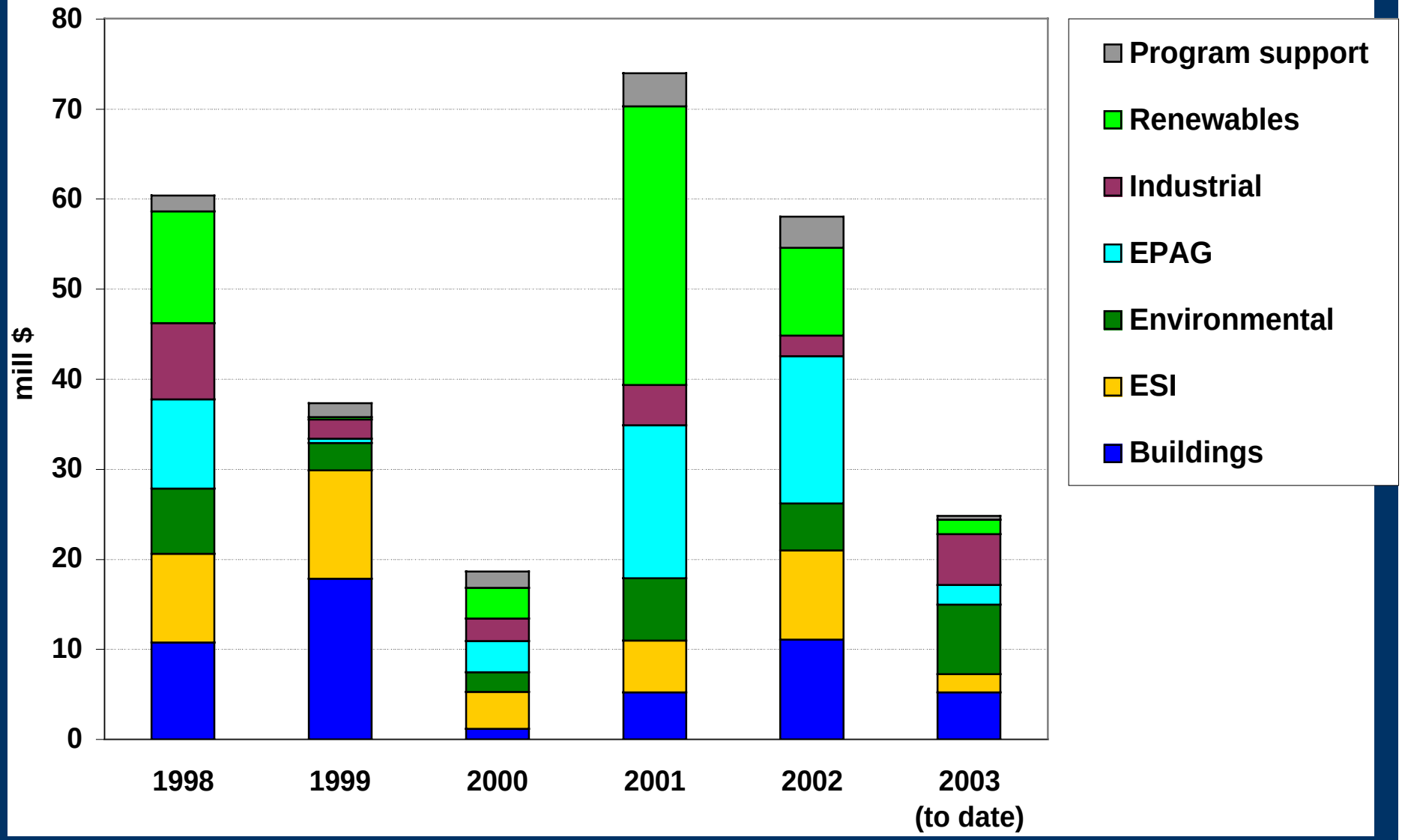
Dynamic Transmission Line Rating

- **Congestion cost $169M on Path 15 in 4th Qtr 2000**
- **System monitors line's tension in real-time**
- **Path 15 demonstration indicating greater than 390 MW increased capacity**
- **Environmental benefit through delay/avoidance of new transmission corridors**

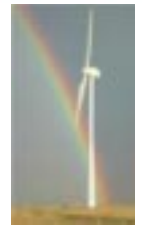
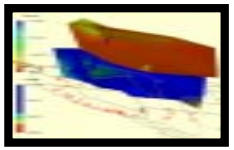
President's Commission on Critical Infrastructure Protection Highlights Vulnerabilities and Interdependencies



PIER Encumbrances by Year and Program Area



CEC/PIER is Already Providing a Stream of Products Consistent with the California Energy Action Plan (CEAP)

CEAP Goal	PIER Issue	Products
Optimize efficiency, Reduce demand	Reduce per capita energy use	 
Ensure power supply meet RPS	MEET RPS	 
Upgrade T&D structure	T&D System must be reliable and congestion-free	 
Promote DG	Peak demand reduction Low emissions DG Reliable, affordable DG	 
Ensure reliable supply of NG	Meet marketplace needs	 

Expectations Include Development & Enhancement of Critical Relationships

- **Success in connecting with peers in DOE and other agencies**
  - **Collaborative funding**
  - **Reciprocity on review teams**
  - **Enhanced CEC visibility: Making a difference on a national level**
- **Maintaining ties with successful contractors**
  - **Stream of products to market**
  - **Step-wise successes from research to deployment**
  - **On-going value to enhance intellectual critical mass**
- **Tying our programs to other state activities and regulations**
  - **Political strength of programs, i.e. ARB, ADF, DWR, SVMB**
  - **Linkage of R&D to implementation: i.e. CEC Efficiency, CEC Renewables, CPUC, ARB**
  - **Linkage to Regulations: SB 1771, SB 1298, CEQA, SB 1078, Title 24**

Driving to a Sustainable Future: The "E"s are Linked

- Environment
- Energy
- Economics
- Equity
- Education